STATOTHR

ENC.

STATOTHR

(1) Technical Proposal IN 462 Revision A
Variable Film Field Reader ~~2 Copies~~
(2) [redacted] Reader Condensed System
(3) See Optical Prints NRI Job # 165, dated 16 Jan. 64.
(4) Viewing Sketch, dated 20 Jan. 64
(5) Schematic & Flow Diagram Job 165, 7 Jan. 64
(6) Job 165 - VFR.
~~(1) Technical Proposal~~

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED

Y	Z
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.100849	.000409-
.201704	.001637-
.302569	.003682-
.403450	.006543-
.504352	.010217-
.605281	.014701-
.706242	.019993-
.807241	.026086-
.908283	.032978-
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1.110524	.049130-
1.211736	.058378-
1.313017	.068398-
1.414374	.079180-
1.515816	.090717-
1.617349	.103000-
1.718982	.116017-
1.820723	.129759-
1.922582	.144214-
2.04567	.159370-
2.126689	.175214-
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2.331385	.208917-
2.433982	.226747-
2.536759	.245208-
2.639732	.264287-
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2.846314	.304228-
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3.577721	.460818-
3.683516	.485048-

STATOTHR

		DATE
DRAWN		
CHECKED		
APPROVED		

TITLE:

ASPHERIC SAG TABLE

ELEMENT 4 R1

CODE IDENT NO.	SIZE	
	A	174-2-1 DWG NO.
SCALE	UNIT WEIGHT	SHEET 2 OF 4

REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED

Y	Z
3.789702	.509674-
3.896303	.534671-
4.003345	.560014-
4.110855	.585675-

STATOTHR

		DATE
DRAWN		
CHECKED		
APPROVED		

TITLE:

ASPHERIC SAG TABLE

ELEMENT 4 R1

CODE IDENT NO.	SIZE	
	A	174-2-1 DWG NO.
SCALE	UNIT WEIGHT	SHEET 3 OF 4

REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED

Y	Z
.000000	.000000
.178002	.001949
.355514	.007777
.532048	.017428
.707117	.030807
.880235	.047778
.965911	.057554
1.050918	.068152
1.135196	.079536
1.218684	.091666
1.301321	.104492
1.383047	.117957
1.463799	.131989
1.519713	.142176
1.559304	.149456
1.640267	.164926
1.720216	.180707
1.799088	.196649
1.876816	.212581
1.953334	.228298
2.006136	.239049
2.054748	.248791
2.161833	.269304
2.236760	.282411
2.310288	.293760
2.382327	.302894
2.452777	.309324

STATOTHR

		DATE
DRAWN	E. K.	1/7/64
CHECKED		
APPROVED		

TITLE:

System - 24X

CODE IDENT NO.	SIZE	DWG NO.
	A	14-2-3

SCALE | UNIT WEIGHT | SHEET 2 OF 2

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED

Y	Z
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.115047	.000564-
.230082	.002254-
.345092	.005070-
.460067	.009009-
.574993	.014068-
.689859	.020243-
.804653	.027528-
.919363	.035917-
1.033979	.045404-
1.148489	.055980-
1.262882	.067638-
1.377147	.080368-
1.491275	.094159-
1.605255	.109001-
1.719077	.124883-
1.832731	.141791-
1.946210	.159713-
2.059504	.178637-
2.172605	.198547-
2.285504	.219429-
2.398196	.241269-
2.510671	.264051-
2.622925	.287758-
2.734951	.312377-
2.846743	.337889-
2.958295	.364278-
3.069604	.391528-
3.180664	.419621-
3.291472	.448541-
3.402025	.478270-
3.512320	.508792-
3.622353	.540089-
3.732124	.572145-
3.841631	.604942-
3.950871	.638463-
3.989043	.650364-

STATOTHR

		DATE
DRAWN		
CHECKED		
APPROVED		

TITLE:

ASPHERIC SAG TABLE

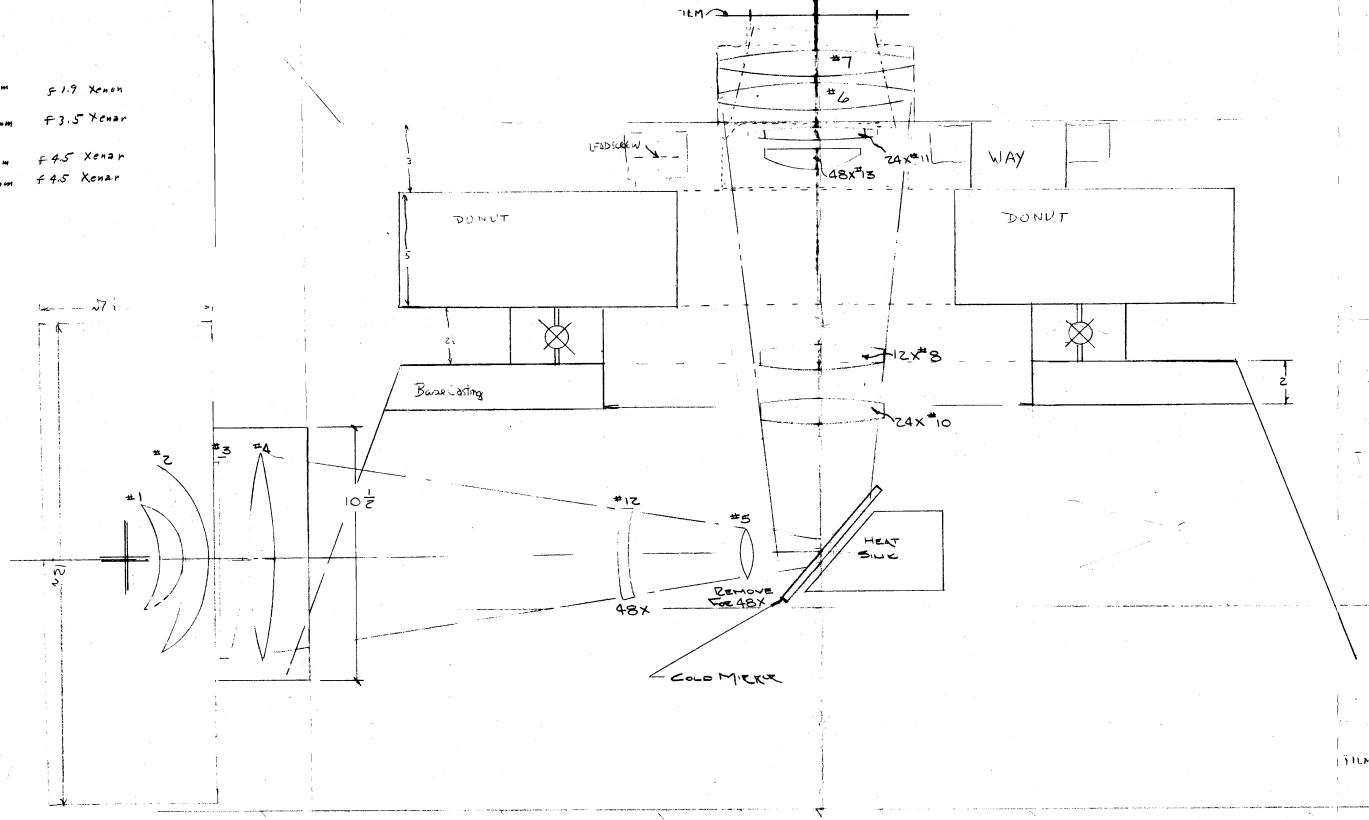
ELEMENT 7 R1

CODE IDENT NO.	SIZE	
	A	174-2-1 DWG NO.
SCALE	UNIT WEIGHT	SHEET 4 OF 4

Lens changer
Fluid CRT
Coupling?
Layout Structure
Array + Auto.

Sanitized Copy Approved for Release 2011/05/24 : CIA-RDP78B04747A001200010001-7

48X	50 mm	F 1.9 Xenon
24X	105 mm	F 3.5 Xenar
12X	180 mm	F 4.5 Xenar
6X	300 mm	F 4.5 Xenar



HALF SCALE

VWFR JOB. 165

REV - 1 12-30-69

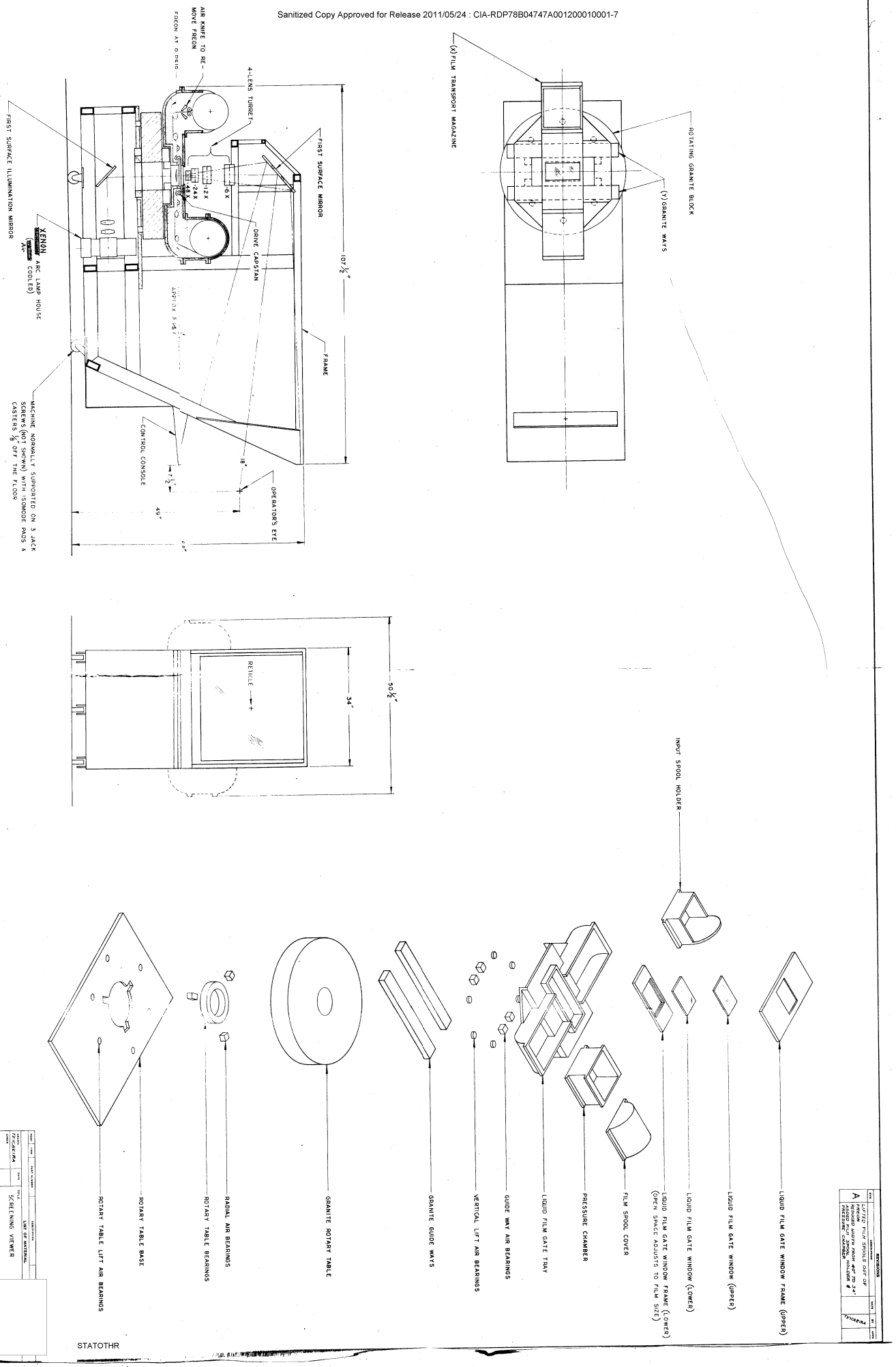
" - 2 1-10-69

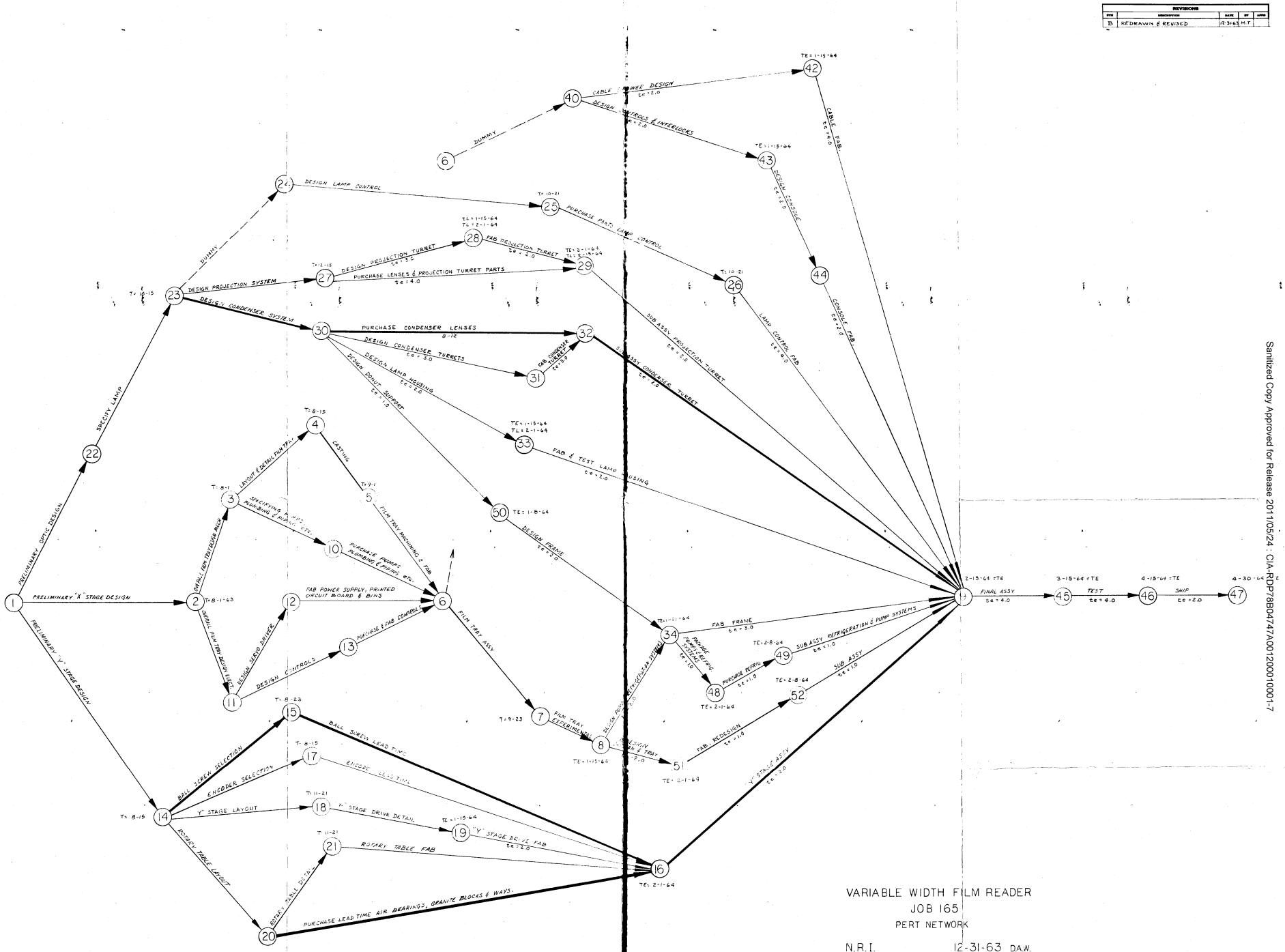
— Lamp Pkg May move out if necessary

> 4" OK TO MOVE THIS DIRECTION

POWER

Lens No	6	12	24	48
1,2,3A,	✓	✓	✓	✓
5	✓	✓	✓	
6,7	✓	✓	✓	✓
8		✓		
10			✓	
11			✓	
12				✓
13				✓



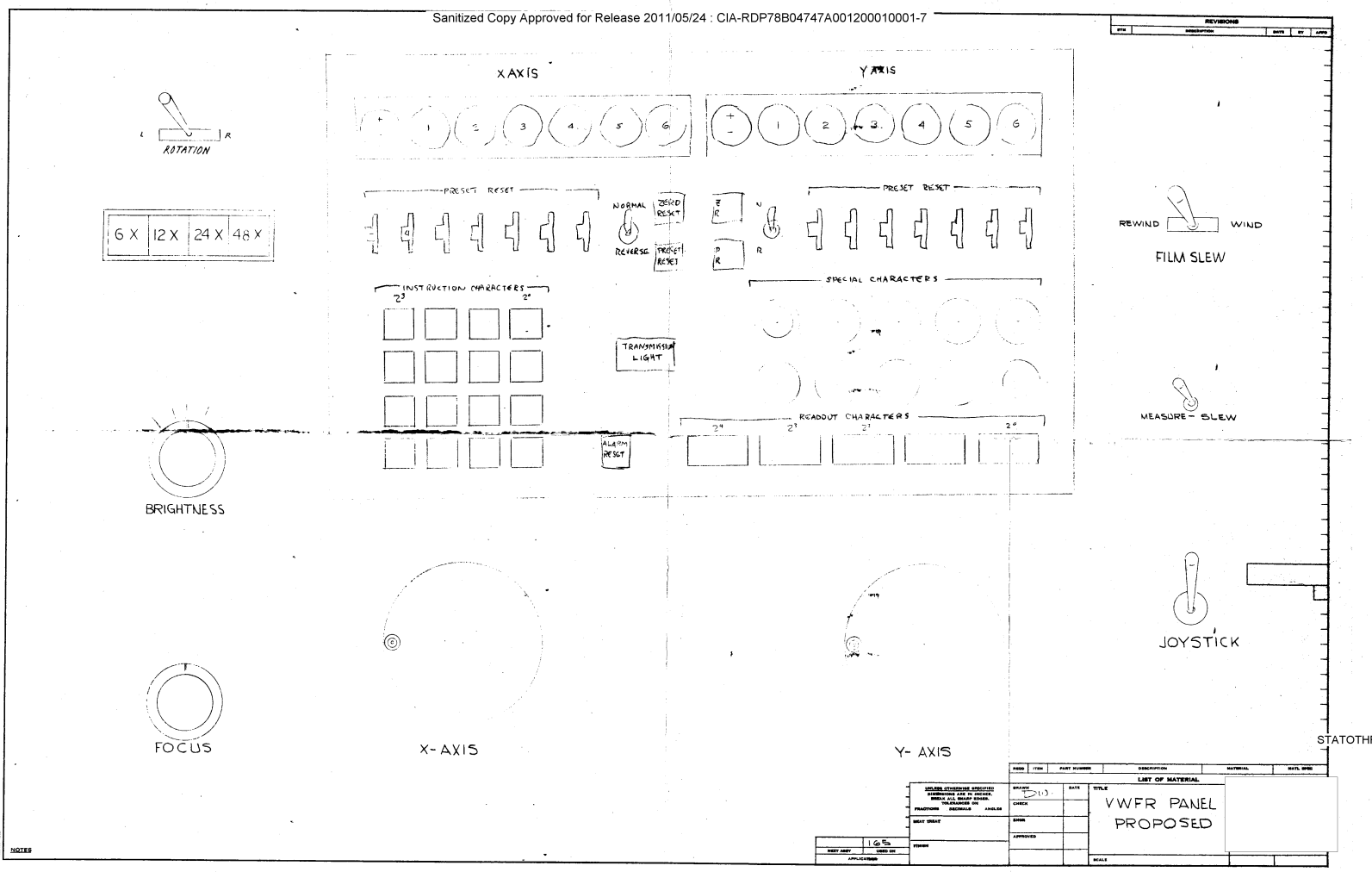


VARIABLE WIDTH FILM READER
JOB 165
PERT NETWORK

N.R.I. 12-31-63 D.A.W.

EE 317-B

Sanitized Copy Approved for Release 2011/05/24 : CIA-RDP78B04747A001200010001-7



SYM	ZONE	REVISIONS DESCRIPTION	DATE	BY	APPROVED
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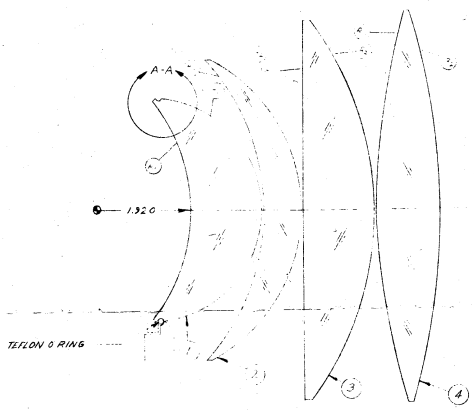
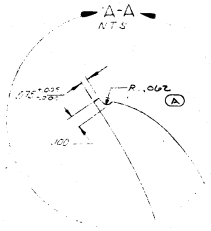


ELEMENT		RADIUS	±1% C.T.	±.005 O.D.	±.005 AIR SPACE	±.005 C.A.	MATERIAL
1	R_1	-3.759	1.500	4.800		4.718	FUSED QUARTZ, GRADE A No 14585
	R_2	-2.404			0.050		
2	R_1	-4.762	0.800	6.400		6.154	FUSED QUARTZ, GRADE A No 14585
	R_2	-3.636			0.050		
3	R_1	+166.667	1.500	8.185		7.986	CROWN, GRADE A No 15230 2 req'd
	R_2	+4.770			0.050		
4	AR R_1	12.422	1.350	8.375		8.067	CROWN, GRADE A No 16230
	R_2	+14.493			21.47		
5	R_1	3.091	0.240	1.650		1.313	FUSED QUARTZ, GRADE A No 14585
	R_2	-15.385			22.050		
6	R_1	30.483	1.050	8.600 (6.08 SQ)		8.306	CROWN, GRADE A No 15230
	R_2	+14.483			0.050		
7	AR R_1	11.740	0.95	8.365 (6.08 SQ)		8.105	CROWN, GRADE A No 15230
	R_2	-53.428					

See Note "5"



5. Elements Nos. 6 & 7 to be cut to 6.08 square

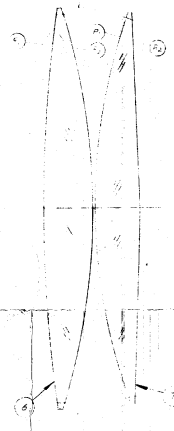
4. See sheet 2 for element data

3. Surface quality 80-50

2. Break sharp edges & remove burrs.

1. Interpret dimensions, symbols, etc. in accordance with listed documents as follows:
   - Dimensions & tolerances ..... MIL-STD-8.
   - Screw thread conventions ..... MIL-STD-8.
   - Surface roughness ..... MIL-STD-10.
   - Abbreviations ..... MIL-STD-12.
   - Screw thread dimensions, tolerances, & identification symbols ..... H28 Handbook

NOTE:



DWG NO. 174-2-1 REV A
SHEET 1 OF 4

STATOTHR

FIND NO.	SYMBOL NO.	REQD	CODE IDENT	PART NUMBER	DESCRIPTION	SPECIFICATION	REV

PARTS LIST

UNLESS OTHERWISE SPECIFIED			DATE
DIMENSIONS ARE IN INCHES	DRAWN	[illegible]	12-14-67
TOLERANCES ON FRACTIONS / DECIMALS / ANGLES	CHECKED	[illegible]	12-14-67
	APPROVED		

DO NOT SCALE DRAWING

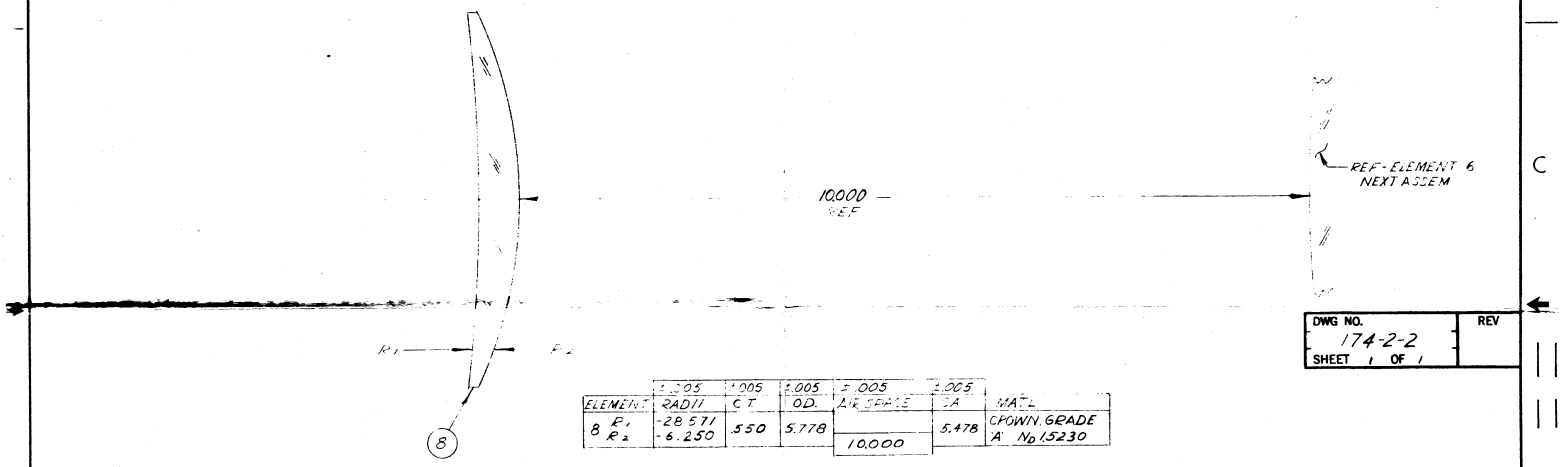
MATERIAL:

CONDENSER SYSTEM - 6 X 30½ mm f45 XMIT

CODE IDENT NO. | SIZE D | 174-2-1A DWG NO.

SCALE 1/1 | UNIT WEIGHT —— | SHEET 1 OF 4

REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED



ELEMENT	±.005 RADII	±.005 C.T.	±.005 O.D.	±.005 AIR SPACE	±.005 LA	MAT'L
8	R1 -28.571 R2 -6.250	.550	5.778	10.000	5.478	CROWN, GRADE A No 15230

DWG NO.	REV
174-2-2	
SHEET 1 OF 1	

FIND NO.	SYMBOL NO.	REQD	CODE IDENT	PART NUMBER	DESCRIPTION	SPECIFICATION	REV

PARTS LIST

STATOTHR

3 SURFACE QUALITY 80-50 PER MIL-O-13830
2. BREAK SHARP EDGES & REMOVE BURRS.
1. INTERPRET DIMENSIONS, SYMBOLS, ETC. IN ACCORDANCE WITH LISTED DOCUMENTS AS FOLLOWS:
DIMENSIONS & TOLERANCES ..... MIL-STD-8.
SCREW THREAD CONVENTIONS ..... MIL-STD-9.
SURFACE ROUGHNESS ..... MIL-STD-10.
ABBREVIATIONS ..... MIL-STD-12.
SCREW THREAD DIMENSIONS, TOLERANCES, & IDENTIFICATION SYMBOLS ..... NBS HANDBOOK H28.
NOTE:

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± DECIMALS ± ANGLES ±
DO NOT SCALE DRAWING
MATERIAL:

		DATE
DRAWN	F.M.J.	1-7-64
CHECKED		
APPROVED		

N/A 74-2-1

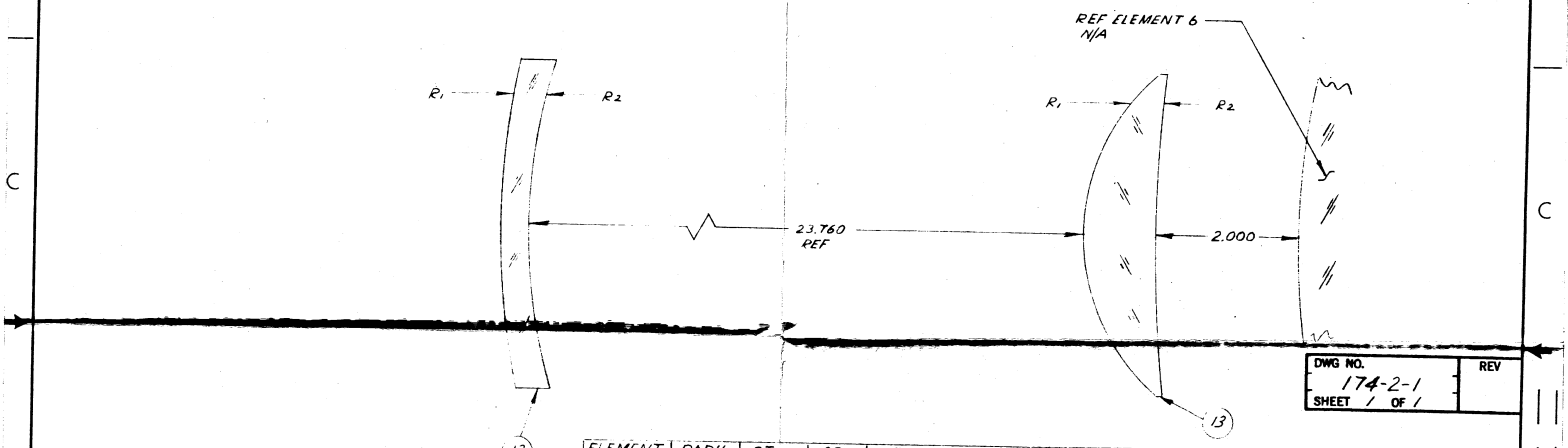
TITLE: SYSTEM-12X
180 mm f4.5 Xenar

CODE IDENT NO.	SIZE	DWG NO.
	C	174-2-2

SCALE 1/1 | UNIT WEIGHT — | SHEET 1 OF 1

LITCH-POST CLEARPRINT 1000H

REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED



DWG NO.	REV
174-2-1	
SHEET 1 OF 1	

ELEMENT	RADII	C.T.	O.D.	AIR SPACE	C.A.	MATL:
12	R1 10.886	0.400	4.600		4.300	CRWN. GRADE A
	R2 7.812			23.760		No 1.5230
13	R1 2.941	1.000	4.500		4.200	CROWN, GRADE A
	R2 20.000					No 1.5230

FIND NO.	SYMBOL NO.	REQD	CODE IDENT	PART NUMBER	DESCRIPTION	SPECIFICATION	REV

PARTS LIST

4. ELEMENT 5 N/A IS REMOVED FOR 48X SYSTEM
3. SURFACE QUALITY 80-50 PER MIL-O-13830
2. BREAK SHARP EDGES & REMOVE BURRS.
1. INTERPRET DIMENSIONS, SYMBOLS, ETC. IN ACCORDANCE WITH LISTED DOCUMENTS AS FOLLOWS:
   - DIMENSIONS & TOLERANCES ..... MIL-STD-8.
   - SCREW THREAD CONVENTIONS ..... MIL-STD-9.
   - SURFACE ROUGHNESS ..... MIL-STD-10.
   - ABBREVIATIONS ..... MIL-STD-12.
   - SCREW THREAD DIMENSIONS, TOLERANCES, & IDENTIFICATION SYMBOLS ..... NBS HANDBOOK H28.

NOTE:

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON: FRACTIONS ±—, DECIMALS ±.005, ANGLES ±—
DO NOT SCALE DRAWING
MATERIAL:

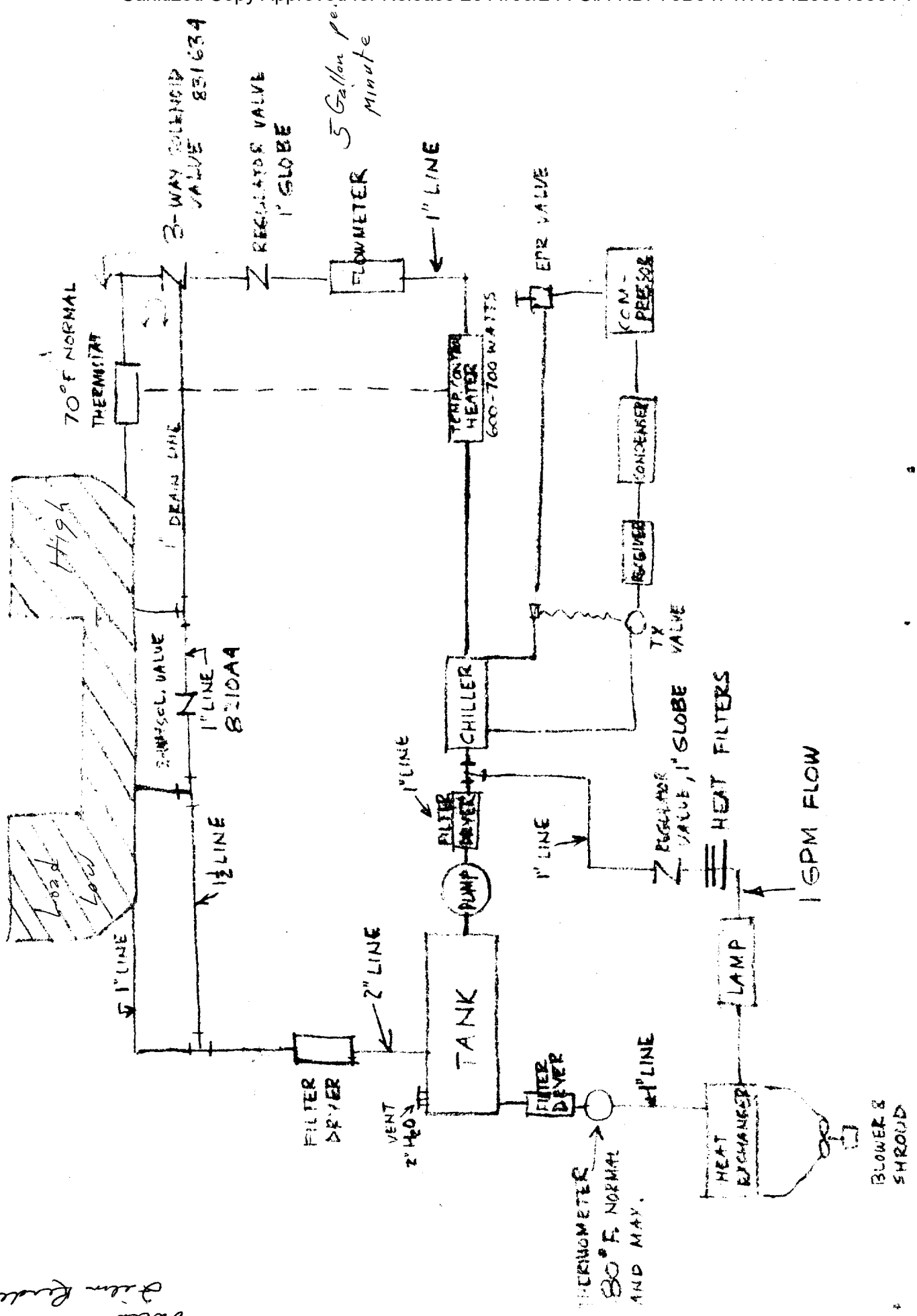
		DATE
DRAWN	RMW	1-7-64
CHECKED		
APPROVED		

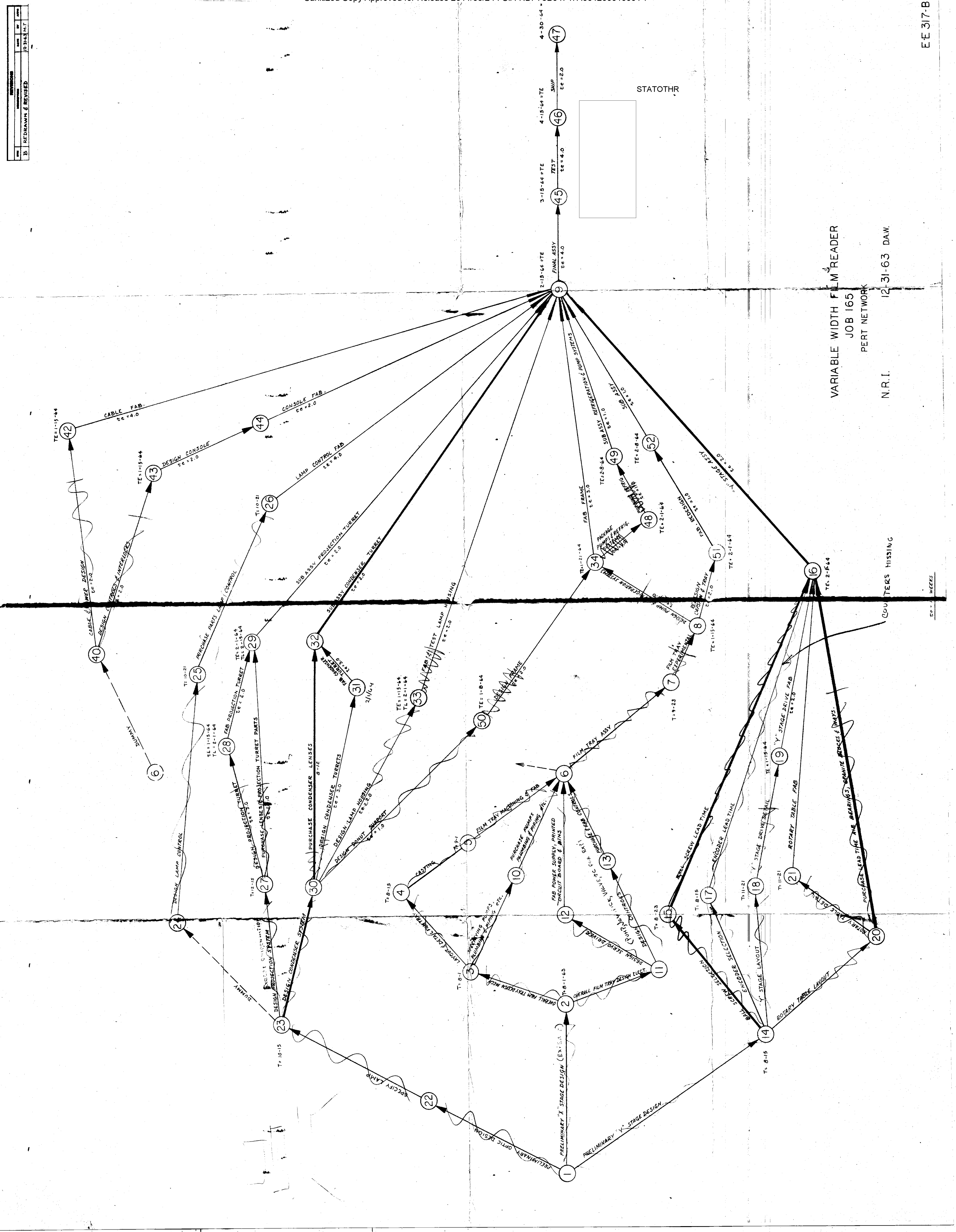
N/A 174-2-1

TITLE: SYSTEM-48X
50 mm f 1.9 Xenon

CODE IDENT NO.	SIZE	DWG NO.
	C	174-2-4
SCALE 1:1	UNIT WEIGHT ——	SHEET 1 OF 1

DIETZGEN-POST CLEARPRINT 1000M





[redacted]

January 16, 1964

Dear John:

STATOTHR In accordance with your request for a set of optical
STATOTHR prints on [redacted] ob 165, enclosed are the following
[redacted] drawings:

174-2-1 (four sheets)
174-2-2
174-2-3 (two sheets)
174-2-4

Very truly yours,

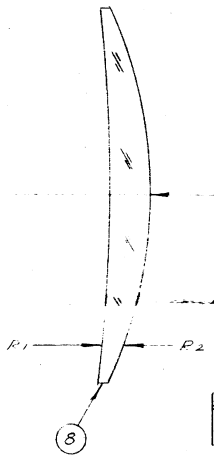
[redacted]

Director of Operations

WHM:jb

STATOTHR

REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED



10.000 REF

REF-ELEMENT 6 NEXT ASSEM

ELEMENT	± 1% RADII	±.005 CT	±.005 OD	± .005 AIR SPACE	±.005 CA	MATL
8	R1 -28.571	.550	5.178	10.000	5.478	CROWN, GRADE A ND 15230
	R2 -6.250					

DWG NO.	REV
174-2-2	
SHEET 1 OF 1	

FIND NO.	SYMBOL NO.	REQD	CODE IDENT	PART NUMBER	DESCRIPTION	SPECIFICATION	REV

PARTS LIST

3 SURFACE QUALITY 80-50 PER MIL-O-13830
2. BREAK SHARP EDGES & REMOVE BURRS.
1. INTERPRET DIMENSIONS, SYMBOLS, ETC. IN ACCORDANCE WITH LISTED DOCUMENTS AS FOLLOWS:
DIMENSIONS & TOLERANCES ..... MIL-STD-8.
SCREW THREAD CONVENTIONS ..... MIL-STD-9.
SURFACE ROUGHNESS ..... MIL-STD-10.
ABBREVIATIONS ..... MIL-STD-12.
SCREW THREAD DIMENSIONS, TOLERANCES, & IDENTIFICATION SYMBOLS ..... NBS HANDBOOK H28.

NOTE:

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± DECIMALS ± ANGLES ±
DO NOT SCALE DRAWING
MATERIAL:

		DATE
DRAWN	RMW	1-7-64
CHECKED		1-7-64
APPROVED		

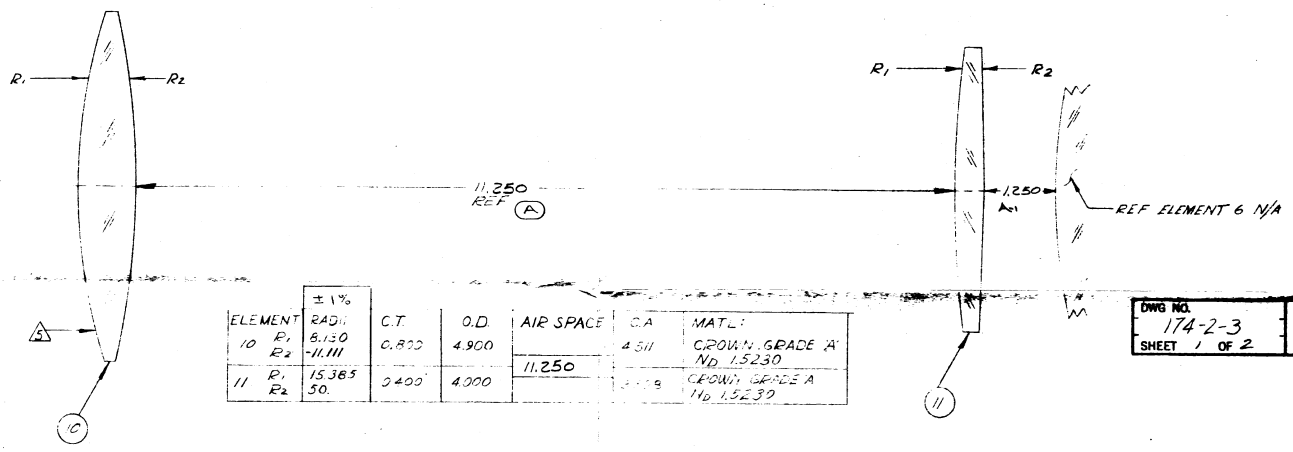
N/A 174-2-1

SYSTEM-12X

CODE IDENT NO.	SIZE	DWG NO.
	C	174-2-2-A
SCALE 1:1	UNIT WEIGHT ——	SHEET 1 OF 1

DIETZGEN-POST CLEARPRINT 1000H

REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED
A		WAS 11.500 / WAS 11.000	9/...	J.G.	...



ELEMENT		±1% RADII	C.T.	O.D.	AIR SPACE	C.A	MATL:
10	R1	8.130	0.800	4.900	11.250	4.511	CROWN: GRADE 'A' ND 1.5230
	R2	-11.111					
11	R1	15.385	0.400	4.000		[illegible]	CROWN: GRADE A ND 1.5230
	R2	50.					

DWG NO. 174-2-3 REV
SHEET 1 OF 2

FIND NO.	SYMBOL NO.	REQD	CODE IDENT	PART NUMBER	DESCRIPTION	SPECIFICATION	REV

PARTS LIST

5 SEE SHEET 2 FOR ASPHERIC DATA TABLE
4 SURFACE QUALITY 80-50 PER MIL-O-13830
2. BREAK SHARP EDGES & REMOVE BURRS.
1. INTERPRET DIMENSIONS, SYMBOLS, ETC. IN ACCORDANCE WITH LISTED DOCUMENTS AS FOLLOWS:
DIMENSIONS & TOLERANCES ..... MIL-STD-8.
SCREW THREAD CONVENTIONS ..... MIL-STD-9.
SURFACE ROUGHNESS ..... MIL-STD-10.
ABBREVIATIONS ..... MIL-STD-12.
SCREW THREAD DIMENSIONS, TOLERANCES, & IDENTIFICATION SYMBOLS ..... NBS HANDBOOK H28.
NOTE:

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± — DECIMALS ± .005 ANGLES ± —
DO NOT SCALE DRAWING
MATERIAL:

		DATE
DRAWN	RMW	1-7-64
CHECKED		
APPROVED		

N/A 174-2-1

SYSTEM - 24X

CODE IDENT NO. | SIZE C | DWG NO. 174-2-3-B
SCALE 1:1 | UNIT WEIGHT —— | SHEET 1 OF 2

STATOTHR

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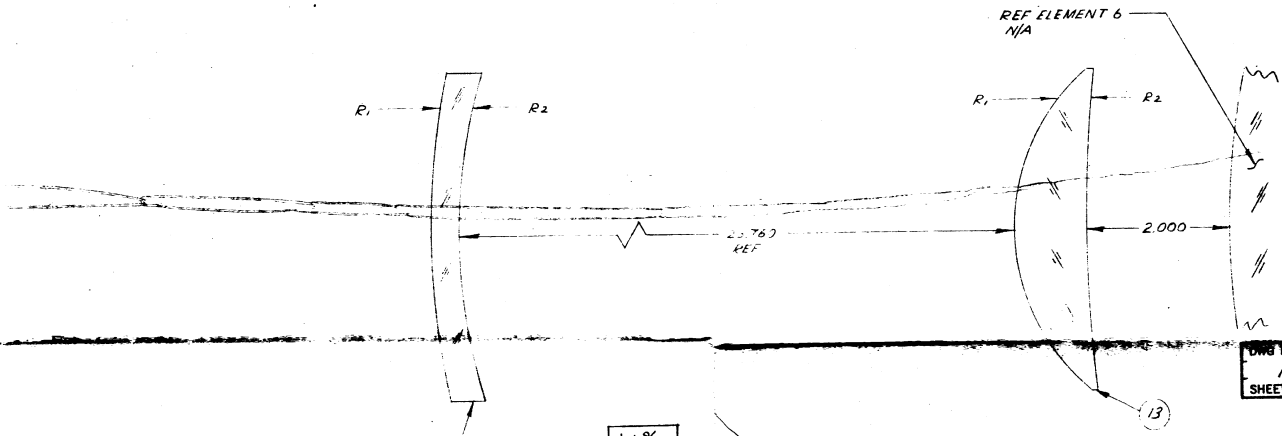
REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED



ELEMENT	RADII ±1%	C.T.	OD	AIR SPACE	CA.	MATL:
12 R1	10.886	0.400	4.600		4.300	CROWN, GRADE A No 1.5230
R2	7.812			23.760		
13 R1	2.941	1.000	4.500		4.200	CROWN, GRADE A No 1.5230
R2	20.000					

DWG NO.	REV
174-2-1	
SHEET 1 OF 1	

FIND NO.	SYMBOL NO.	REQD	CODE IDENT	PART NUMBER	DESCRIPTION	SPECIFICATION	REV

PARTS LIST

4 ELEMENT 5 N/A IS REMOVED FOR 48X SYSTEM
3 SURFACE QUALITY 80-50 PER MIL-O-13830
2. BREAK SHARP EDGES & REMOVE BURRS.
1. INTERPRET DIMENSIONS, SYMBOLS, ETC. IN ACCORDANCE WITH LISTED DOCUMENTS AS FOLLOWS:
DIMENSIONS & TOLERANCES ..... MIL-STD-8.
SCREW THREAD CONVENTIONS ..... MIL-STD-9.
SURFACE ROUGHNESS ..... MIL-STD-10.
ABBREVIATIONS ..... MIL-STD-12.
SCREW THREAD DIMENSIONS, TOLERANCES, & IDENTIFICATION SYMBOLS ..... NBS HANDBOOK H28.
NOTE:

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON FRACTIONS ± —, DECIMALS ± .005, ANGLES ± —
DO NOT SCALE DRAWING
MATERIAL:

		DATE
DRAWN	RMW	1-7-64
CHECKED		
APPROVED		

N/A 174-2-1

TITLE: SYSTEM-48X

CODE IDENT NO. | SIZE C | DWG NO. 174-2-4-A

SCALE 1:1 | UNIT WEIGHT —— | SHEET 1 OF 1

STATOTHR

DIETERICH-POST CLEARPRINT 1000H

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED

Y	Z
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.178002	.001949
.355514	.007777
.532048	.017428
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1.383047	.117957
1.463799	.131989
1.519713	.142106
1.559304	.149456
1.640267	.164926
1.720216	.180707
1.799088	.196649
1.876816	.212581
1.953334	.228298
2.006136	.239049
2.054748	.248791
2.161833	.269304
2.236760	.282411
2.310288	.293760
2.382327	.302894
2.452777	.309324

STATOTHR

		DATE
DRAWN	E. K.	1/7/64
CHECKED		
APPROVED		

TITLE:

System - 24X

CODE IDENT NO.	SIZE	DWG NO.
	A	174-2-3

SCALE | UNIT WEIGHT | SHEET 2 OF 2

SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED
		REVISIONS			

Y	Z
.000000-	.000000
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.345092	.005070-
.460067	.009009-
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.689859	.020243-
.804653	.027528-
.919363	.035917-
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1.262882	.067638-
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1.491275	.094159-
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1.946210	.159713-
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2.172605	.198547-
2.285504	.219429-
2.398196	.241269-
2.510671	.264051-
2.622925	.287758-
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2.958295	.364278-
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3.180664	.419621-
3.291472	.448541-
3.402025	.478270-
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3.622353	.540089-
3.732124	.572145-
3.841631	.604942-
3.950871	.638463-
3.989043	.650364-

STATOTHR

		DATE
DRAWN		
CHECKED		
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T

ASPHERIC SAG TABLE

ELEMENT 7 R1

CODE IDENT NO.	SIZE	
	A	174-2-1 DWG NO.
SCALE	UNIT WEIGHT	SHEET 4 OF 4

REVISIONS					
SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED

Y	Z
3.789702	.509674-
3.896303	.534671-
4.003345	.560014-
4.110855	.585675-

STATOTHR

		DATE
DRAWN		
CHECKED		
APPROVED		

TITLE:

ASPHERIC SAG TABLE

ELEMENT 4 R1

CODE IDENT NO.	SIZE	
	A	174-2-1 DWG NO.
SCALE	UNIT WEIGHT	SHEET 3 OF 4

REVISIONS

SYM	ZONE	DESCRIPTION	DATE	BY	APPROVED

Y	Z
.000000-	.000000
.100849	.000409-
.201704	.001637-
.302569	.003682-
.403450	.006543-
.504352	.010217-
.605281	.014701-
.706242	.019993-
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.908283	.032978-
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2.126689	.175214-
2.228958	.191735-
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2.433982	.226747-
2.536759	.245208-
2.639732	.264287-
2.742912	.283966-
2.846314	.304228-
2.949954	.325056-
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3.158009	.368334-
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3.367213	.413644-
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3.577721	.460818-
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STATOTHR

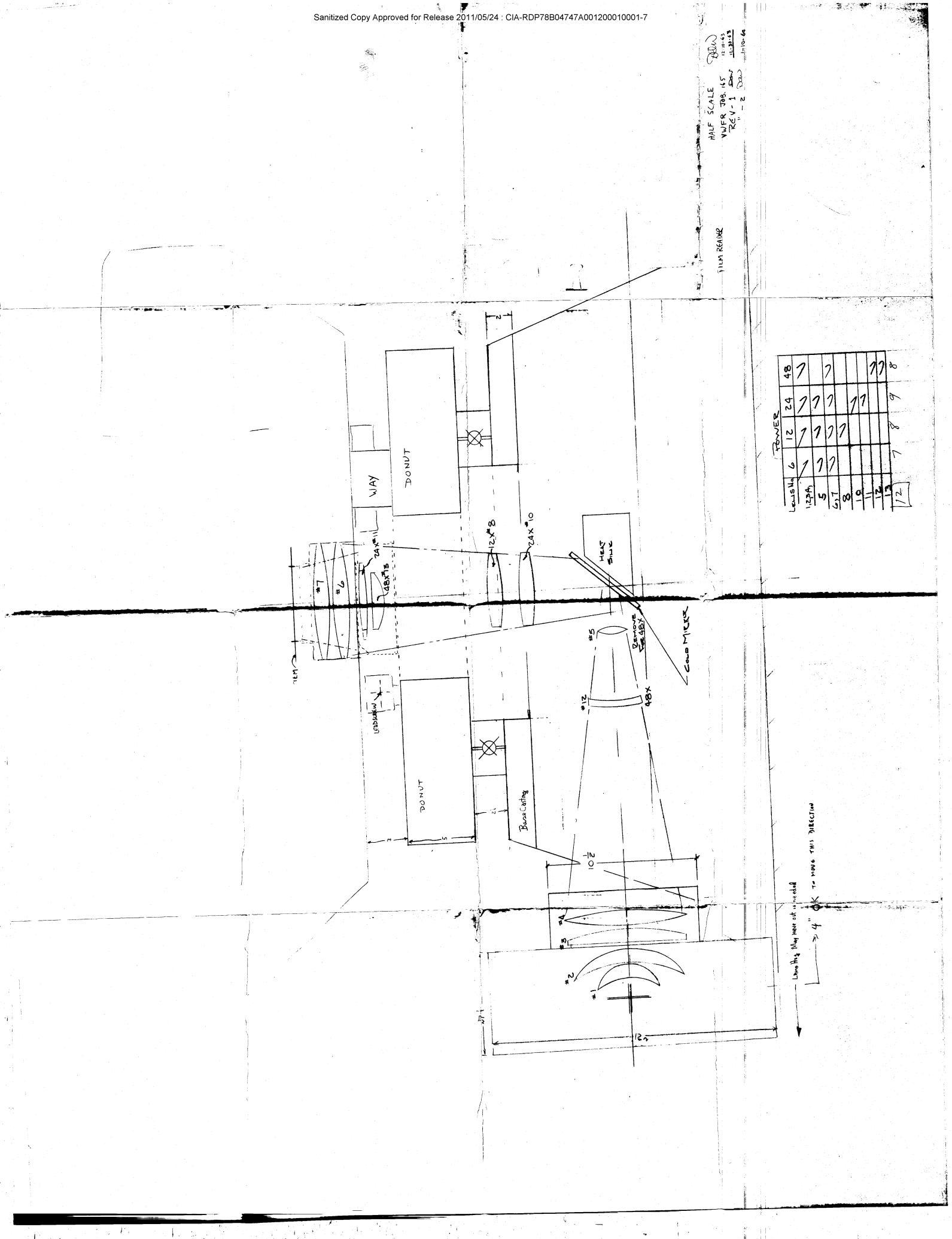
		DATE
DRAWN		
CHECKED		
APPROVED		

TITLE:

ASPHERIC SAG TABLE

ELEMENT 4 R1

CODE IDENT NO.	SIZE	
	A	174-2-1 DWG NO.
SCALE	UNIT WEIGHT	SHEET 2 OF 4



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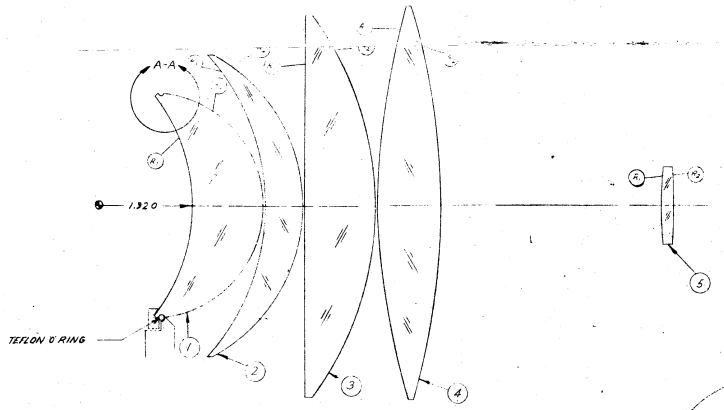
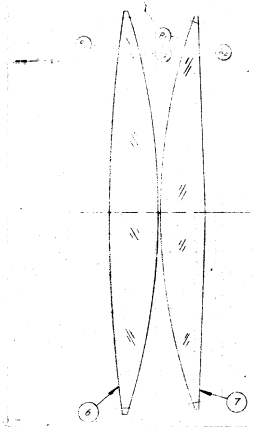
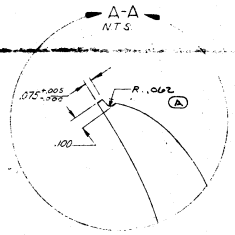
A		WAS 1175	12-16-65	VG	





ELEMENT		RADIUS	±1%	±.005 C.T.	±.005 O.D.	±.005 AIR SPACE	±.005 C.A.	MATERIAL
1	R_1	-3.759	1.500	4.900			4.719	FUSED QUARTZ, GRADE A Per 14585
	R_2	-2.404			5.050			
2	R_1	-4.762	0.900	4.920			5.154	FUSED QUARTZ, GRADE A Per 14585
	R_2	-3.636			5.050			
3	R_1	+166.667	1.100	R .75			7.756	CROWN GRADE A Per 15230
	R_2	+6.770			5.070			
4**	R_1	12.422	1.350	R.375			8.087	CROWN GRADE A Per 15230
	R_2	-4.493			2.147			
5	R_1	3.031	0.243	1.610			13.3	FUSED QUARTZ, GRADE A Per 14585
	R_2	+15.385			22.060			
6	R_1	36.483	1.350	8.622 (6.08 SQ)			8.356	CROWN GRADE A Per 15230
	R_2	-14.451			5.353			
7**	R_1	11.740	0.95	8.365 (6.08 SQ)			8.105	CROWN GRADE A Per 15230
	R_2	-53.648						

See Note "5"



5. Elements Nos. 6 & 7 To Be Cut To 6.08 Square.

4 SEE SHEET 2 FOR ASPHERIC SAG TABLE ELEMENT 4&7
3 SURFACE QUALITY 80-50
2. BREAK SHARP EDGES & REMOVE BURRS.
1. INTERPRET DIMENSIONS, SYMBOLS, ETC. IN ACCORDANCE WITH LISTED DOCUMENTS AS FOLLOWS:
DIMENSIONS & TOLERANCES ..... MIL-STD-8.
SCREW THREAD CONVENTIONS ..... MIL-STD-8.
SURFACE ROUGHNESS ..... MIL-STD-10.
ABBREVIATIONS ..... MIL-STD-12.
SCREW THREAD DIMENSIONS, TOLERANCES, & IDENTIFICATION SYMBOLS ..... RBS HANDBOOK H28.
NOTE:

FIND NO.	SYMBOL NO.	REQD	CODE IDENT	PART NUMBER	DESCRIPTION	SPECIFICATION	REV
				PARTS LIST			

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UNLESS OTHERWISE SPECIFIED			DATE
DIMENSIONS ARE IN INCHES	DRAWN	RAH	12-16-65
TOLERANCES ON FRACTIONS / DECIMALS / ANGLES	CHECKED	RSW	12-16-65
	APPROVED		
DO NOT SCALE DRAWING			
MATERIAL:			

CONDENSER SYSTEM - 6 X

CODE IDENT NO. | SIZE D | 174-2-1A | DWG NO.

SCALE 1/1 | UNIT WEIGHT | SHEET 1 OF 2

5 April 1963
I.N. 462, Rev. A

STATOTHR

TECHNICAL PROPOSAL
I.N. 462 - Revision A

VARIABLE WIDTH FILM READER

TABLE OF CONTENTS

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Section I

INTRODUCTION

This proposal includes revisions and changes made in the Variable Width Film Reader specifications up to 5 April 1963. These changes relate to the overall size of the machine, the illumination source, and the film transport mechanism. Drawings F145A (figure 1) and B931A (figure 2) are changed to show the new requirements. In other major features - such as film measurement, rotation, lens selection - it remains the same as described in the NRI proposal dated 15 February 1963.

The instrument described in the following sections is an operating engineering prototype, but throughout its design and construction every effort will be made to include the refinements necessary to a production model.

Section II

TECHNICAL PROPOSAL

INTRODUCTION

This technical proposal outlines a system which will have the operating features specified in "Design Requirements for a Variable Film Width Reader" and revisions. Image rotation, high resolution, illumination and high-speed film transport are the major design problems.

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Preliminary study by [redacted] has resulted in an outline proposal for a system to meet all the operational specifications for the Variable Width Film Reader. In this discussion, we will present design and support data for each necessary subsystem, along with the performance that can be expected from optimized components.

The equipment configuration shown in the specification drawing will be followed, in general, in the layout of the final measuring machine. An overall height of 64" and length of 108" should be sufficient to contain all necessary components. The width at the front of the machine will not exceed 34 inches. As will be explained, the design process must begin with the requirement for high intensity illumination, which demands a

liquid cooling system. This in turn affects the film drive design, and the complete film transport dictates characteristics of the rotating mechanism.

1. FILM COOLING

The major problem in the specification is the intense illumination required on the screen. For metered film drive, the film can not be in contact with a glass platen. Government sponsored research is now in progress on a liquid Freon film gate, in which the film is suspended between horizontal planes of laminar flow in a stream of liquid Freon, (see figure 1). The Freon flows between parallel glass plates, which form a platen containing the film and holding it in the viewing plane. It absorbs heat from the illuminated film area and recirculates through a heat exchanger, where the Freon is cooled.

Figure 2 shows the supply and take-up reels both suspended over the cooling fluid, as they will be during measurement. Freon 113 will be used as the cooling liquid. It will be filtered as it recirculates, to remove any dust which enters from the film. A pressure differential across the gate of approximately 8 psi is expected to produce appropriate flow rates. A spacing between the glass plates and the film of .001" to .005" seems to be stable for a range of flow rates.

In the proposed Screening Projector, the major purpose of the "liquid gate" approach is to cool the film by a process of conduction (film to fluid) and convection (heated fluid is pumped from the platen to a heat exchanger). A mixture of nine parts of toluene and one part of Freon-113 liquid is recommended; this mixture is colorless, has low toxicity, is less expensive than Freon-113 liquid alone, and has an index of refraction of 1.50. Therefore scratches and other marks on either side of the film itself are not visible in the projected image. Eastman Kodak has established that there are no dimensional changes to their film (all types) as a result of being exposed to a liquid Freon cooling system.

2. FILM TRANSPORT

2.1 Measurement

Distances on the film are to be measured to a least count of 10 microns over a range of 30 inches along the film, and up to 9 1/2 inches across the film. The instrument will accommodate film widths from 70mm to 9 1/2 inches. Measurement accuracy will be as specified; that is:

Accuracy of ∠25 microns over any area on the film 70 mm square

Accuracy of ∠1mm over an area on the film of 9 1/2" x 30".

Such a measurement of film distances implies a driving and metering roller which maintains tension on the film in the viewing region, and also a transverse movement of film across its width. The first is described below under "Film Drive" and the second in paragraph 3. under "Stage and Rotation".

2.2 Film Drive

Figure 2 is a schematic diagram of the entire film drive system. Supply and take-up reels at either side hold the film, which

may be from 70mm to 9 1/2" wide. Power for driving the two reels is supplied by their respective servo motors and amplifiers, but film speed is controlled by a capstan drive in the pressurized side of the film chamber. The film is driven by the pressure differential capstan shown in figure 3, and metered by an Optisyn encoder which gives film travel in increments of 10 microns over a range of 30". Tension sensing rollers supply feedback signals to the servo amplifiers which drive the film reels. The film speed control for measurement is interlocked with magnification selection (see Section 6 for more detail).

Magnification	Joystick Ranges	Median Speed
48X	0.02"/sec-0.1"/sec	0.05"/sec
24X	0.05"/sec-0.2"/sec	0.1"/sec
12X	0.1"/sec -0.4"/sec	0.2"/sec
6X	0.2"/sec -0.8"/sec	0.4"/sec

A second one-axis joystick will be used for film rewind and fast advance. Maximum deflection of this "film slew" joystick will produce a minimum speed of 250 ft/min. It will override the "measurement" joystick. At this time insufficient data is

available to establish a final design; however it appears that for protection of film and film platens, the fast slew and rewind should take place with Freon running through the gate as it does during viewing and measurement.

Connected to the driving shaft (see figure 2) are the X encoder, the pressure differential capstan (described in more detail below), the speed control servo motor, a clutch-brake, and a selsyn. Inputs to the servo amplifier may come either from one potentiometer on the joystick or from the primary winding of the receiver selsyn, which senses position of the handwheel (see figure 4). When the speed control joystick is off zero, the clutch disengages the selsyn from the drive shaft. When the joystick is at zero, the clutch engages the secondary of the selsyn to the drive shaft.

Output of the servo amplifier is a DC signal, controlling velocity of the Model 368 printed circuit motor. This motor turns the capstan and encoder, giving the X coordinate for film measurement. The capstan circumference is 163,840 microns. The encoder is a Model 35 Optisyn with 16,384 counts per turn, each count representing 10 microns.

Because of the solvent properties of Freon, all electrical components are in the room atmosphere, separated from the Freon by seals. The pressure differential capstan which supplies film speed control consists of a slotted roller moving over a stationary cylinder, also filled with fluid at lower pressure. Since the Freon hydrostatic pressure in the chamber is approximately 8 psig, the differential pressure between this and atmosphere holds the film tightly against the roller as it turns. By blocking off different regions of the low pressure side, the same roller can be adjusted for the various film sizes. See figure 3 for capstan details.

The film reel drive motors are Model 488 DC printed circuit motors driven by servo amplifiers. Input signals for these amplifiers come from tension sensing rollers on either side of the platen, and maintain a constant film tension across the platen region.

Liquid Freon 113 recirculates from the atmospheric side through a heat exchanger to the high pressure chamber. The pressure chamber and the configuration of platen and film

rollers will be designed to sustain constant laminar flow through the platen region. Spacing between film and the glass plates must be approximately .004 inch, according to information currently available.

Both Freon and air are pressurized in the right-hand side of the chamber. A strip of 70mm leader material is permanently attached to the take-up reel, and the "supply" film will be taped to the leader end, on loading, so that the operator need not thread film through the platen each time. An "air knife" at the supply side, removes liquid Freon so that the reel will be dry when removed.

When the Freon pump is turned off, the liquid is removed from the platen region into a reservoir so that all guide rollers are accessible. To change film width, different size rollers and adapters are placed on each spindle. The center of the film will always be on the same line, no matter what width film is used, so that the center of rotation always lies in the film frame. Interlocks and "end-of-film" detectors will be included to prevent the operator from pulling the end of the film off the supply reel.

3. STAGE AND ROTATION

The image on the display screen should be rotatable $\pm 180^{\circ}$ about its normal position so that imagery can be oriented in the most readable direction for the operator. However, X and Y measurement must be referred to film coordinates; therefore a crosswire measurement on the screen is not appropriate, since it involves encoding rotation and adding this data to the screen measurements in order to find true film positions. Therefore we must rotate the film itself, and with it the measuring system. A simple and practical method of rotating the film, film drive, and measuring devices is based on [redacted] development work with air bearing granite engines. STAT

Assume that the film reels, platen, motor, vacuum rollers and "X" drive components are mounted in a single housing, which forms a "Y" stage. The "Y" stage "floats" on a set of air bearing pads which ride on a flat granite surface (see figure 1). In the center of the cylindrical granite table is an opening for illumination, and the film gate moves over this opening. A pair of ways attached to the cylindrical granite table at either side of the opening rotate around the center measuring axis with the table. The entire film assembly moves back and forth along these ways, with the direction of

movement driven and encoded. Therefore X and Y measurements always represent distances along the film and across the film, respectively. The image presented to the operator, however, can be turned $\not\leq 180^{\circ}$ without affecting measurement. Rotation is used only as a convenience in viewing, and is not encoded.

Figure 1 shows the general layout of the machine, and details of the Y-stage and rotation. The exploded view, at the right of the drawing, shows components for rotation and Y-motion.

A steel base plate is mounted to the instrument frame. The circular collar has three radial air bearings for guidance as it turns in the base plate opening. This collar is rigidly connected to the cylindrical granite block. Air bearings support the weight of the granite upon the base plate. Therefore the granite is free to turn around the center of the opening. A motor-driven belt coupling drives the granite, in response to the operator's setting.

The two granite ways mounted on the top of the rotatable granite table are shown on figure 1. They guide the "Y" travel of the film transport magazine (the unit containing film reels, drive motors, Y-encoder and liquid-cooled platen).

The Y-stage will be driven by a 0.1" pitch precision ball screw using a preloaded nut pair to eliminate backlash. A 254 count per turn Optisyn encoder directly coupled (1:1) to the ball screw will produce a least count of 10 microns. Fast Y slew will be 1"/sec. (maximum deflection of the "measuring" joystick).

4. PROJECTION SYSTEM

Four lenses in a rotating turret provide magnifications of 6X, 12X, 24X, and 48X. Appropriate condensers will be switched into the optical path to follow the magnification change. A front-surface mirror directs projected light to the screen. A rear projection screen, 30" x 30", will be located above the console control panel. The reticle projected on the screen from a point at the rear of the machine will present a pattern suitable for the imagery being measured. The pattern will consist of lines in the selected figure, and the width of the lines will be approximately 0.0025 inch. At 48X magnification, the 10 micron least count of the measuring system will be easily noticeable on the screen.

4.1 Lens Turret

Four lenses called for in the specification will be mounted on a rotating turret above the film plane. Conventional lenses of appropriate resolution for the four magnifications have been selected for the prototype which will give at least 10 lines per mm at the screen, viewing film through an all-air path. Special lenses, corrected for viewing through the glass-Freon section of the optical path, may be developed to the purchaser's specifications, and would be incorporated later.

Prototype Lenses

Magnification	Focal Length	F-Number Needed	F-Number Available
48X	50 mm	1.8	1.4
24X	100 (75)	3.5	2.3
12X	180 (150)	5.6	4.5
6X	300	8.0	6.3

4.2 Since only one mirror is used in the projection path, it is adequate to use commercially available polished plate glass, silvered at the front surface, for this application. Glass selected and treated in accordance with our usual practices will be of appropriate quality for this purpose, flat to within 1 wavelength (Helium yellow line) in one inch.

4.3 Screen

A number of screen materials are now available with resolution of 10 lines/mm or greater. Polacoat, Inc. manufactures a type LS75BG transmission screen with contact resolving power of approximately 30 lines per mm. Its 50% fall-off angle is 13°, allowing the operator at least average freedom of movement from a central position. Until better material becomes available, a commercial screen of this kind will be used.

5. ILLUMINATION

The specified magnifications are 6X, 12X, 24X, and 48X. At 6X, the illuminated film area is a 5" square; at 48X, the illuminated area is 0.6" square. The magnification ratio, highest to lowest, is 8; the area ratio is 64. In order to maintain the same brightness on the screen, the light intensity on the film at high magnification must be 64 times as great as that at low magnification.

The amount of power required at the light source, assuming it to be visible light, is defined by the specification of 10 footlamberts at the screen through a film of neutral density of one. This is the minimum value acceptable, with a design goal of 100 footlamberts. By the definition of density, the incident energy must be ten times as great as the energy falling upon the 30" x 30" screen. At high magnification, the condenser system will be switched to concentrate this light into the small visible area, 0.6" x 0.6". Other factors which enter into a specification for light source are the efficiency of the source, the wave length distribution of the source emission, and absorption within the condensing system. The specification calls for continuously variable intensity.

Using the configuration of equipment shown in figure 1, we can estimate the screen illuminance that would result from a 2500 watt lamp as 16 footlamberts with film density of 1.0. This value is above the specified minimum of 10, but does not approach the design goal of 100. Mercury arc lamps are not available as standard items for more than 6,000 watts. The choice between an arc lamp and a tungsten-iodine light source depends on availability. Within three months after contract, [redacted] will consult with the purchaser to decide upon the light source to be used in the prototype Variable Width Film Reader. STAT

If a mercury arc lamp is used in the prototype machine, Hanovia Lamp Division of Englehard Industries, Newark, New Jersey produces a unit with source area 6.5mm x 10mm, and average power consumption of 6 kilowatts. With this spectrum, the expected screen luminance will be between 35 and 40 footlamberts. However, if a tungsten-iodine lamp of equal output is developed during early stages of the equipment design, [redacted] would prefer to incorporate it as the light source. STAT

6. CONTROLS

See figure 5 for a preliminary layout of the control panel. Controls located on the console are:

1. Magnification selector - four illuminated pushbuttons which select the projection lens, condenser, and film speed - only one can be energized at any time.

2. Image rotation - turns entire X-Y measuring and guide system around the central measuring axis - is not encoded - changes orientation of picture on the screen by rotating the cylindrical granite table and film drive. Also turns the "measuring" joystick.

3. "Measuring" joystick - the standard [redacted] joystick assembly STAT will be used to produce two DC signals proportional to displacement of the handle along perpendicular axes. This assembly will turn to follow the rotation of the table and film magazine. Therefore displacement of the joystick in a given direction will always drive the image on the screen to the same direction. The signals from this joystick, both X and Y components, are interlocked with magnification setting so that the image

velocity at 6X for a given deflection is the same as the image velocity at 48X (see section 2. for median speeds). The Y-deflection of the joystick is spring-loaded to return to zero; the X-component of joystick deflection may be set to a position, and will remain at that position until the operator returns it to center.

4. Film slew joystick - forward or reverse for slew and rewind - carries film along X direction of measurement.

5. X handwheel - selsyn coupling to film drive capstan for fine positioning.

6. Y handwheel - carries film, rollers, reels, and motors along guide ways perpendicular to film direction.

7. Illumination control - varies intensity of illumination at the screen.

8. Film load - lighted pushbutton to release safety interlocks on housing, pump and stage drives, and evacuate Freon from chambers.

Since no data electronics are included with the system, except the encoders themselves, [redacted] will lay out the control panels to accommodate data control switches and indicators specified by the purchaser. STATOTHR

7. REFERENCES

"Contact Printing" by John G. Stott, George E. Cummins, Henri E. Breton, October 1957 Journal of the SMPPE

"Optical Printing" by John R. Turner, Duane E. Grant, Henri E. Breton, October 1957 Journal of the SMPTE

"Rear Projection Screen Materials Study," R. R. McHail, F. K. Soll, Bausch & Lomb Photographic Systems Development Department

"Manual of Physical Properties of Kodak Aerial & Special Sensitized Materials" compiled by Department GS, Eastman Kodak Company

"The Sensations" H. Pirenne

"Physiological Optics, Vol II" Le Grand

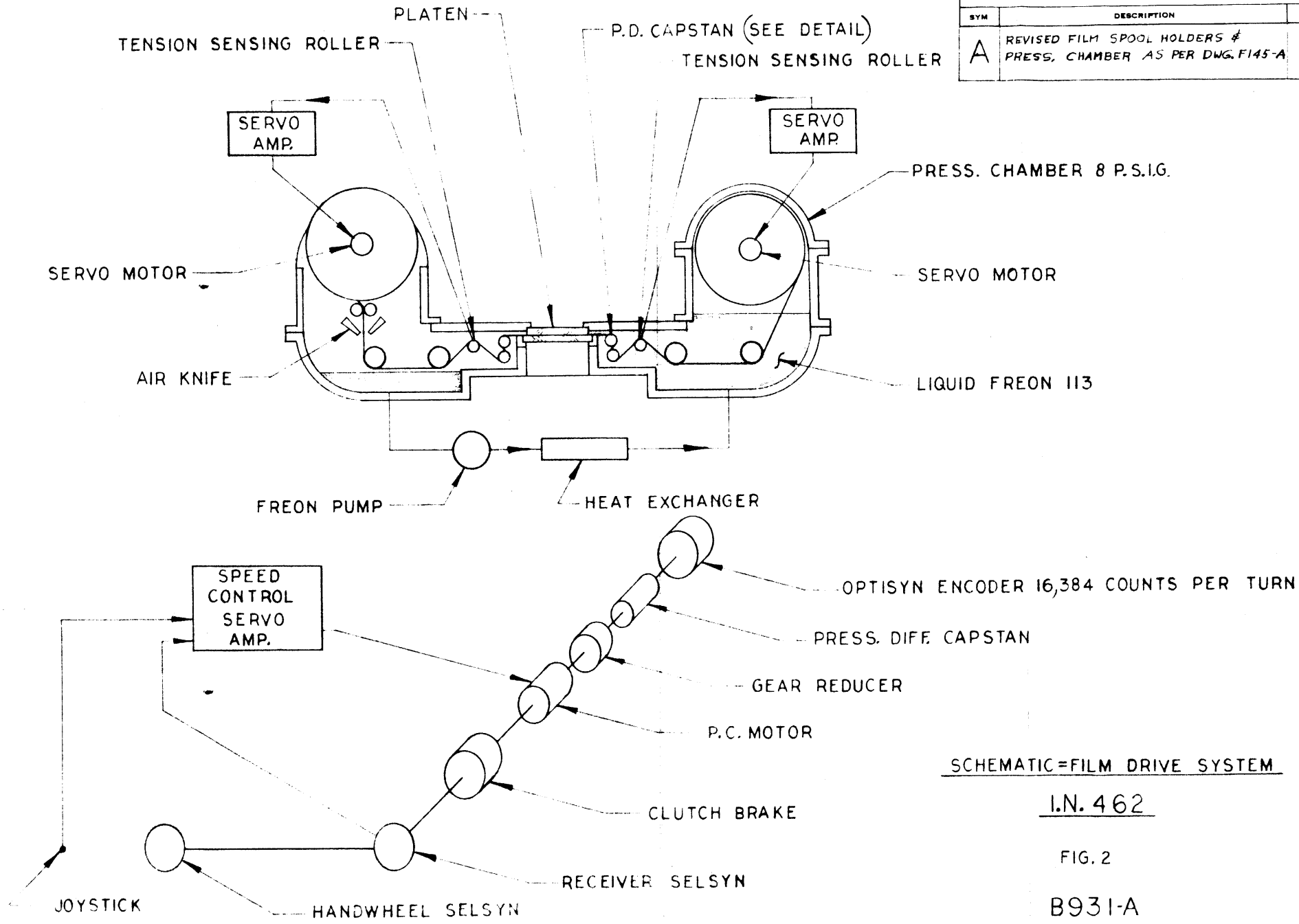
"Textbook of Opthalmology" Duke Elder

Section III

DRAWINGS

Figure 1 (Rev. A)	Equipment Configuration	F145A
Figure 2 (Rev. A)	Schematic, Film Drive System	B931A
Figure 3	Differential Pressure Capstan	A1641
Figure 4	Detailed Block Diagram for Film Drive Control	A1642
Figure 5	Control Panel	A1689

REVISIONS			
SYM	DESCRIPTION	DATE	BY
A	REVISED FILM SPOOL HOLDERS & PRESS. CHAMBER AS PER DWG. F145-A		TELICHERA



SCHEMATIC=FILM DRIVE SYSTEM

I.N. 462

FIG. 2

B931-A

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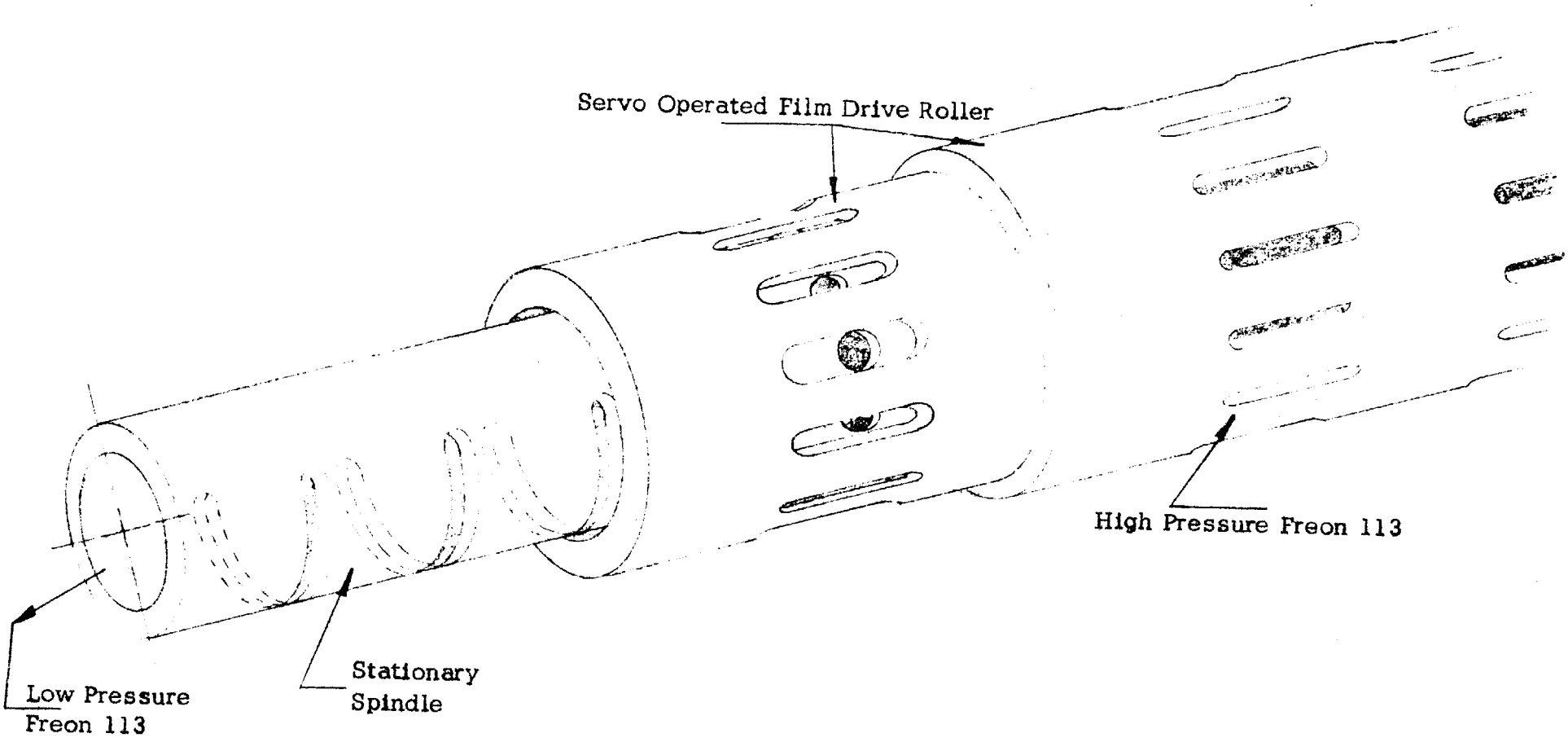

FIGURE 3

DIFFERENTIAL PRESSURE CAPSTAN

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A1641

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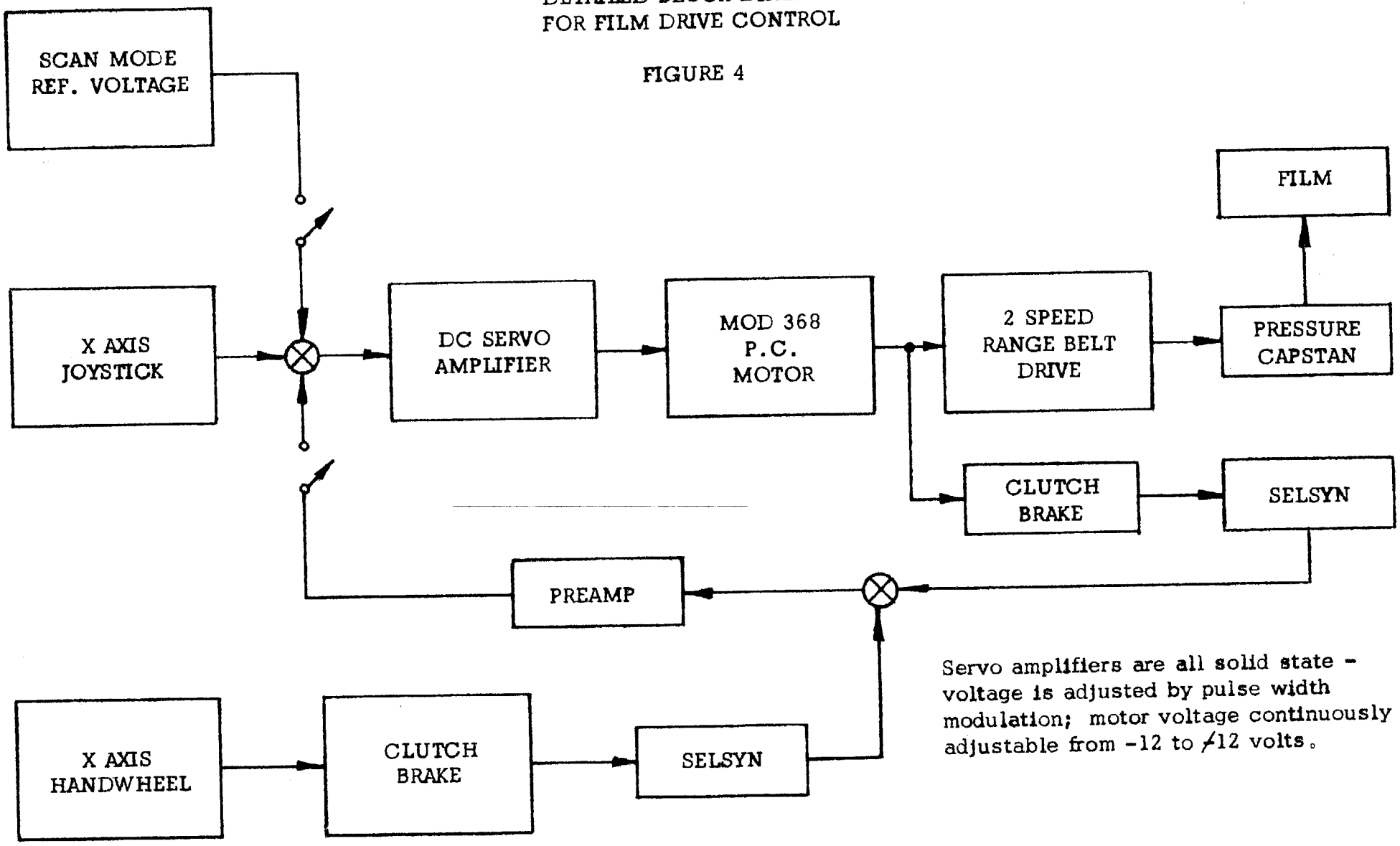
DETAILED BLOCK DIAGRAM
FOR FILM DRIVE CONTROL

FIGURE 4



Servo amplifiers are all solid state - voltage is adjusted by pulse width modulation; motor voltage continuously adjustable from -12 to +12 volts.

I.N.462

A1642

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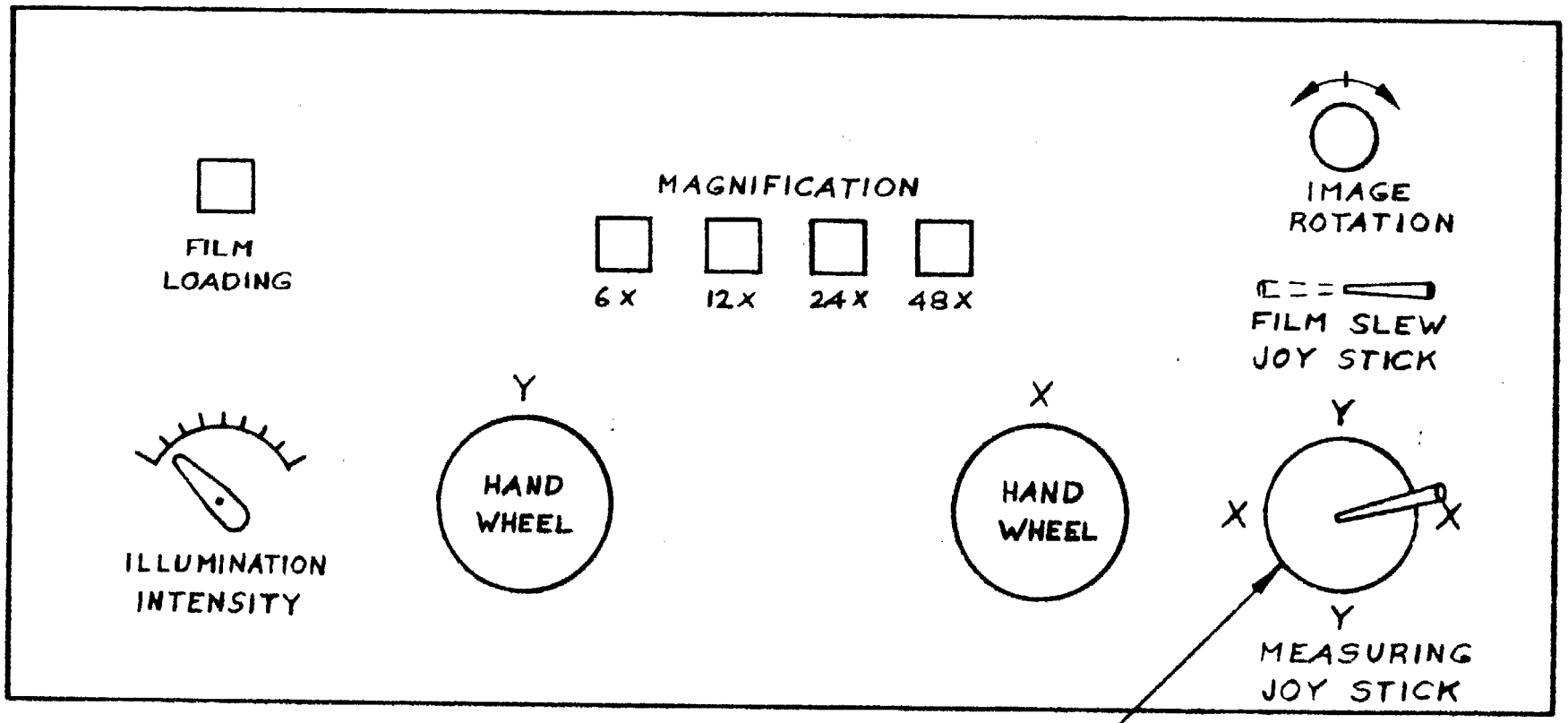

CONTROL PANEL
FIG. 5

A1689

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DESIGN REQUIREMENTS FOR A VARIABLE WIDTH FILM READER

Due to the great diversity of photographic formats available and the unique problems of each, it is no longer feasible to design a film reader for each format or use the conventional moving cross wire measuring techniques. Therefore, the following design characteristics have been established for a multiple format film reader. These specifications are not absolute requirements that must be held to, but only objectives which we feel are within the state of the art. Also attached for information purposes only is a general description of the readout to be used with the reader but is being contracted for separately. A delivery schedule of approximately nine months is desired for a working model with production models following in an additional six months. Cost estimates are required for the production of the first model and for production runs of 10 each. Any interested parties are requested to submit proposals by 18 February 1963.

METHOD OF MEASUREMENT

1. The single frame area over which measurements are to be accomplished may vary from 70mm to 9½" wide with lengths in excess of 30".

2. Measurement along the length of the film is to be accomplished by metering the film movement through the film gate. Measurement across the width of the film is to be accomplished by measuring the movement or displacement of the film gate, including the film transport system, with respect to the optical axis.

3. Minimum acceptable accuracy to be ± 25 microns over an area 70mm square, and ± 1mm over an area of 9½" x 30". Design objective is to have a least count of 10 microns.

4. The digital accumulator and associated data output devices to be designated at a later date by the contracting agency and for the purpose of the proposal are not to be included in the quoted price.

5. Space is to be provided on the control panel for a visual display unit consisting of a sign and 6 digits per axis, two counter reset buttons, a numerical preset rotary switch for each decade, two preset switches, two direction of count toggle switches, twenty-one push type illuminated switches similar to the flat fact micro switches, and ten rotary twelve position switches. The maximum depth of any item does not exceed six inches.

VIEWING SYSTEM

1. Film viewing to be accomplished by a rear projection screen of 30" x 30" approx. dimensions. The screen material to be specified by the contracting office at a later date. The viewing screen shall be either vertical or tilted slightly forward.

2. Four projected magnifications of 6X, 12X, 24X and 48X ± 5% are to be provided, although the 48X lens may be retrofitted at a later date if necessary.

A zoom lens covering the same magnification range will be acceptable provided it meets the other requirements.

3. Image resolution on the screen to be a minimum of 10 lines per mm on axis at all magnifications. However, 5 lines per mm wil be acceptable at 48X as an interim measure until a better lens system can be developed. At no point on the 30" x 30" screen will the resolution be less than 75% of the above values. Resolution acceptance test to be performed at final destination with a 100 to 1 contrast resolution target manufactured by the [redacted] STAT

4. Measuring reference lines to be either fixed wires mounted to the focal plane of the screen, lines etched to the focal plane of the screen, or projected if this method does not affect other specifications such as screen brightness. The thickness of the reference lines to be approximately .0025.

5. The screen brightness from the position of the observer will have a minimum acceptable luminance of 10 ft-lamberts with a design objective of 100 ft-lamberts at each magnification. This luminance will be measured with a neutral density of 1.0 density filling the film plane. The screen will be evenly illuminated and at no point will the illumination deviate by more than 10%. It is required that the light intensity be variable.

6. Image rotation will be required. The minimum requirement is $\pm$ 90°, however complete 360° rotation is desirable. It is understood that the image rotation is to be used for orientation purposes only and shall not be used during the measurement process.

7. A minimum number of mirrors are to be used for folding purposes. The suggested layout allows for one fold, consequently one first surface mirror, the coated surface of which is to be downward facing to minimize collection of dust. However, if rotation of the platen/measuring engine mechanism compromises the accuracy or efficiency of the measuring engine, it will be abandoned in favor of an optical rotation system, i.e., "K" mirror or prism. The "K" mirror system presently appears less desirable.

FILM TRANSPORT

1. Film transport to accommodate various widths of roll film ranging from 1000 foot rolls of 70mm to 500 foot rolls of 9½" material of standard film thickness. However, the transport should be so designed to permit use of thin base material. A wide variety of film spools may be used but shall generally conform to Air Force specs.

a. Film cutting tolerances (slit widths) in the preparation of raw stock as furnished by the Eastman Kodak Company is as follows:

For aerial films, the widths and tolerances are in accordance with American Standard PH 1.10, 1952 and Military Specification MIL-F-32B, June 3, 1958. These are as follows:

Nominal Widths	Width Aims (In.)	Tolerances (In.)
70 mm	2.754	±0.002
5 inch	4.960	±0.010
7 inch	6.991	±0.010 - 0.005
9½ inch	9.460	+0.010 - 0.005

Two sizes are not covered by American Standard nor the Military Specification. Our current size and tolerances are as follows:

Nominal Widths	Width Aims (In.)	Tolerances (In.)
6.6 inch	6.600	+0.010 - 0.005
8.0 inch	7.960	+0.010 - 0.005

Thirty-five millimeter material is always slit to motion picture standards and in accordance with American Standard PH 22.93 and others. This dimension and tolerance is as follows:

Nominal Width	Width Aim (In.)	Tolerance (In.)
35mm	1.377	± 0.001

2. Design of the transport shall insure safe handling of film, both standard and thin base, at all speeds, i.e., no stretching, tearing, frilling edges, scratching, etc.

3. Three film drive speed ranges are to be provided.

a. High speed rapid advance/rewind. The maximum speed to be dictated by safe film handling practices.

b. Scan speed to provide suitable viewing speed at all magnifications. Film speed to be variable within any given range and smooth at all speeds. The speed range shall vary from just barely moving on the screen at 48X to the fastest at which an operator can adequately watch it at 6X. The range of speed may be operated in increments consistant with the magnification.

4. Pressure platen cannot be accommodated due to flow film measuring method.

5. Temperature of film within film gate not to exceed 20° F. above ambient of 75° F. with an average density film of 1.5. (Silver halide emlusion)

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